"ALL ON SHORT" PROSTHETIC-IMPLANT SUPPORTED REHABILITATIONS

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SUMMARY
Objectives. Short implants are increasing their popularity among clinicians who want to fulfill the constant demanding of fixed prosthetic solutions in edentulous jaws. The aim of this report was to propose a new possibility to project and realize an occlusal guided implant cross-arch prosthesis supported by ultra-short implants, describing it presented an edentulous mandible case report.
Methods. A 61-year-old, Caucasian, female patient who attended the dental clinic of the University of L'Aquila presented with edentulous posterior inferior jaw and periodontitis and periimplantitis processes in the anterior mandible. The remaining tooth and the affected implant were removed. Six 4-mm-long implants were placed to support a cross-arch metal-resin prosthesis.
Results. At 1-year follow-up clinical and radiological assessment showed a good osseointegration of the fixtures and the patient was satisfied with the prosthesis solution.
Conclusion. The method, even if it requires further validation, seems to be a valid aid in solving lower edentulous clinical cases, and appears less complex and with more indications of other proposals presented in the current clinical literature. Our case report differs from the current technique All-on-Four, which uses four implants in the mandible to support overdenture prosthesis, assuring a very promising clinical result.

Key words: atrophic jaw, ultra-short implants, occlusal guided cross-arch prosthesis.

Introduction

Oral diseases affecting soft and hard tissue as well as traumatic injuries can lead to tooth loss and consequent atrophy of the alveolar bone of the jaws. While removable prosthesis is a relatively safe therapy option, the mobility of the device often represents the main discomfort complained by the patients. Excessive bone loss does not assure the denture retention and consequent instability during the normal daily oral functions can occur (1). Fixed rehabilitation on implants can achieve high success level (2) but rehabilitating atrophic jaws is challenging, especially in those cases where the bone defect is wide (3). The resorption of the available bone entails that the alveolar crest gets closer to the noble anatomical structures (maxillary sinus and alveolar nerve) in the superior and inferior jaws. In classical implant dentistry a minimal bone height of 10 mm is required to insert implants with property length (4). The length is considered one of the factors that are determinant for a long and favorable prognosis. Despite the modern Guided Bone Regeneration (GBR) techniques, the implant placement in a jaw with low bone level is not predictable (5). Augmentation surgical techniques, in fact, are technically challenging and operator-dependent; moreover, they are associated with significant postoperative morbidity and complications, can be expensive and may require longer time (up to 1 year) for prosthetics-loading (6).

The definition of "short" implants is still controversial: some Authors consider "short" implants those with a length ranging between 7 to 10 mm (1); others consider "short" those fixtures with an intra-bony length of 8 mm or less than 9 mm (7). The definition of ultrashort implants was used by Deporter et al. reporting the survival rates of maxillary and mandibular 5-mm-long porous-surfaced implants (8).

The present report describes the 1-year follow-up of a fixed-implant supported rehabilitation, using 4 mm short implants in the mandible and a prosthesis realized following the gnato-physiology of the patient.

Indeed, basing on the new assumptions of the implant stability, and on the immediate-loading of implant in technique such as all-on 4, the implants were inserted following also the gnatological needs as we describe below.

Methods

A 61-year-old, Caucasian, female patient showed attendance at the dental clinic department of the University of L'Aquila. The patient was complaining of a localized pain in the mental region. The nature of the pain was referred to be both provoked and spontaneous. In addition, the patient referred to have masticatory problems. At the intraoral inspection, the patient was wearing a superior removable denture and, inferiorly, only the anterior teeth group was rehabilitated by means of fixed cemented crown. The fixed-rehabilitation crowns extended from 4.4 to 3.4 (Figure 1). The signs of an inflammatory process affecting 4.2 and 3.3 elements were visible.

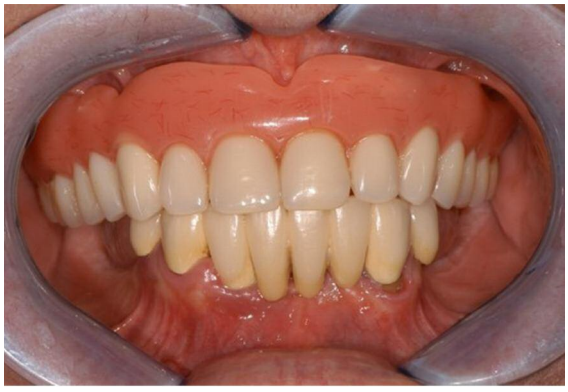

Figure 1
Clinical situation of the patient.

In addition, 4.2 tooth presented a 7-mm-deep periodontal pocket.

Orthopantomography (OPT) showed that 3.3 element was affected by acute periodontitis. The implant in 4.2 position was affected by periimplantitis and the 4.3 root was extremely resorpted (Figure 2).

The clinical situation and the wishes of the pa-

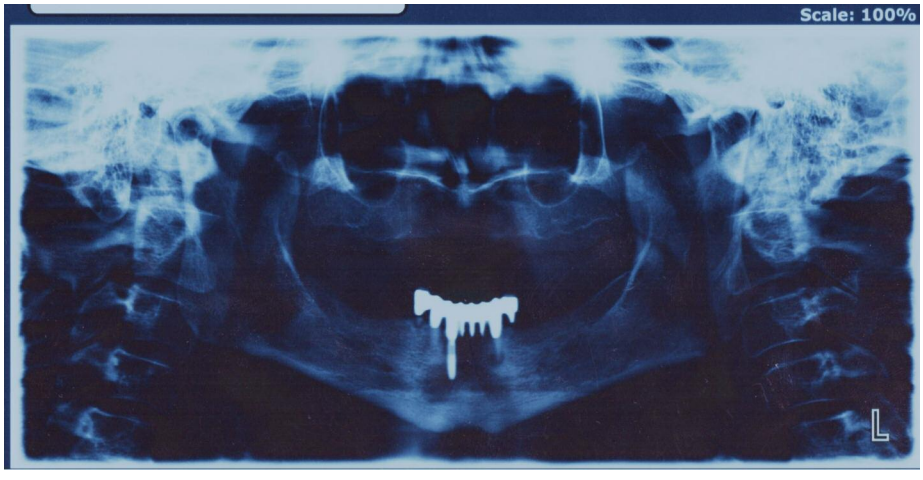

Figure 2
Orthopantomography of the patient, showing osteolytic lesion on the 3.3 element, inflammation lesions around the implant and the poor length of the 4.3 root.

tient required the following therapy plan:

1. extraction of all the dental elements and implant removal from the mandible;
2. placement of a Toronto-type, implant-supported prosthesis.

In order to evaluate the detailed anatomy of the mandibular bone for an appropriate treatment approach, a cone beam computed tomography was prescribed.

From the radiological study, the distance between the alveolar crest and the mandibular canal measured from less than 10 mm to 5 mm (Figure 3).

Due to the bone availability, the ultra-short (4 mm long) dental implant Twinkon4, TEKKA, Global D, was chosen. This type of implant is a grade 5 titanium alloy (TiAI6V4), sandblasted and double etched, with a surface roughness of 1-2 µm.

Since the masticatory loading is in the molar region, it was decided to insert 4.5 mm diameter implants in those position. In the premolar-canine region, it was planned to insert 4 mm diameter implants. In order to reduce the anterior cantilever, the surgical planning included to insert only one anterior implant. The site of insertion of the implants has been programmed through a gnathological occlusion analysis and by means of a series of prosthetic references. One of them is the neutral space, a virtual space where the muscular strengths of tongue and buccal muscles do not act (9).

Indeed, as stated earlier (10), the occlusal rehabilitation should follow the neuromuscolar and physiological patterns of the patient, to provide optimal implant load and to ensure long-term implant success.

After 1 year, the results were performed both by the usual clinical and radiological indicators and through the evaluation of patient satisfaction with a specific questionnaire on the same model

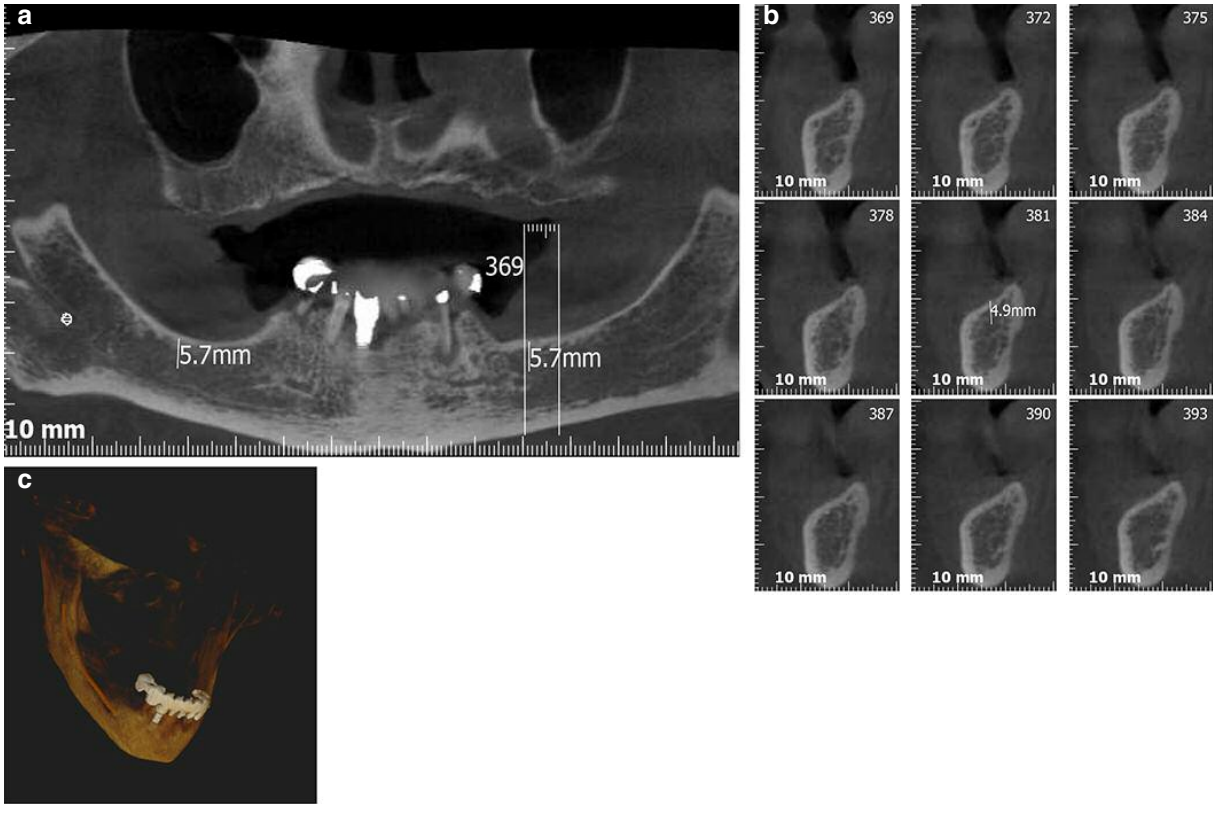

Figure 3
Radiological study of the case. a,b) Measurements distance of the alveolar crest to the alveolar cana; c) tri-dimensional view.

earlier tested (11). The questionnaire, that was in Italian language and reported here in English language, included the following questions:

1. 'My crown/my bridge functions very well, and I can chew on it very well'
2. 'I feel more secure biting on my new prosthesis'
3. 'To speak, I can very well use my crown/bridge'
4. 'I am pleased with the aesthetic results'
5. 'I can clean my implants very well'
6. 'I got exactly what I expected'
7. 'I would like this treatment again, if needed'
8. 'I would recommend this treatment to a friend or relative, if indicated?'

Patient was required to give a mark choosing between "Yes, definitely" "Enough" "Not at all".

Surgical procedure

Mouth was disinfected with clorexidine 2% mouthwash. Perioral skin tissues were disinfected by means of iodopovidone (Betadine 10%, Meda). Inferior alveolar nerve block was performed and reinforced with local anesthesia.
The anesthetic administered was articaine 4% with epinefrine 1:100.000 (CITOCARTIN "100" Molteni Dental).

Teeth were extracted. The provisory denture with the implant marks was tried on (Figure 4).
The implant sites were prepared using the TEK-KA protocol of drilling, with the crescent diameters tips from 2.0 to 4.0 mm. The implant were inserted with a 60 N torque.
The previous implant was removed three months after the surgical procedure described above.

Prosthodontics procedure

The transfer abutments were replaced with abutment screw-retained prosthesis. The rubber dam was used to prevent the blocking resin from going under the implant neck. The provisory denture was placed and then blocked by means of the specific resin. The margins were refined to assure a proper oral hygiene (Figure 5).
At the 3-months follow-up (Figure 6) precision impression was taken. The metal-bar was realized (Figure 7). After the metal structure was tried on, the final resin prosthesis was realized and applied.

Results

The OPT and the measured periapical radiographs at 1-year follow-up showed a good bone margin

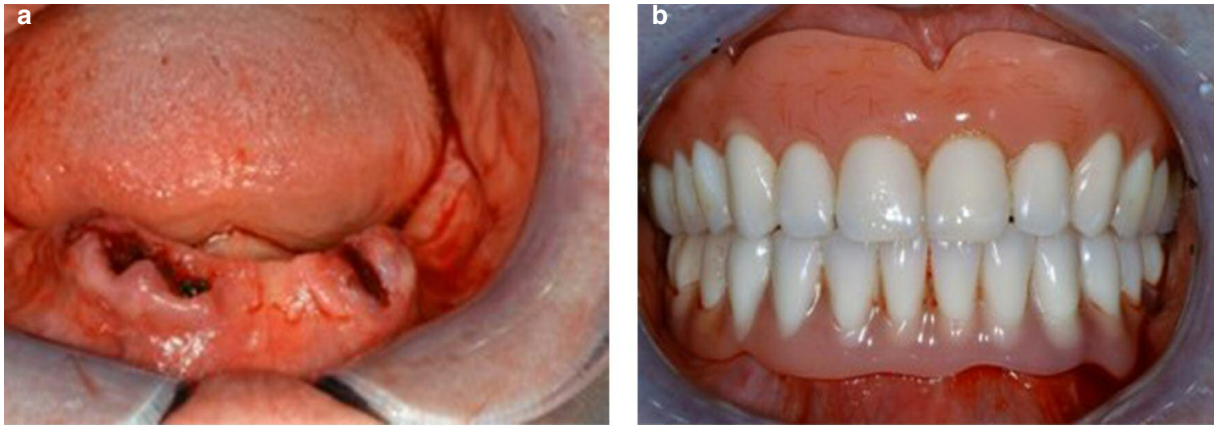

Figure 4
a) Teeth extraction; b) provisional denture try.

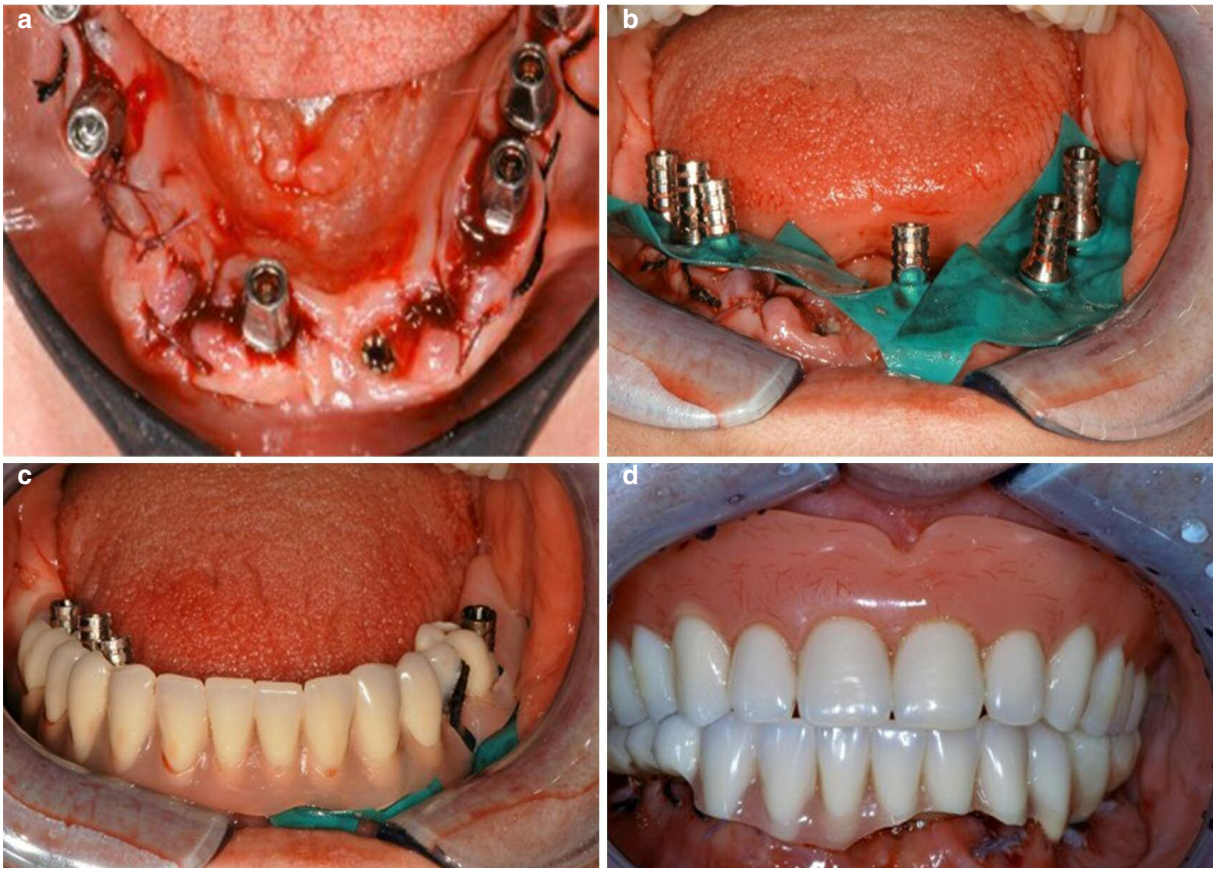

Figure 5
a) Implant insertion according the previously chose positions; b) rubber dam placement; c) placing of the provisional denture; d) finishing of the margins for a correct oral hygiene.

level around the implants (Figures 8, 9). The clinical result was acceptable (Figure 10).

The answers to the questionnaire statements were:

Figure 6
3 months OPT follow-up.

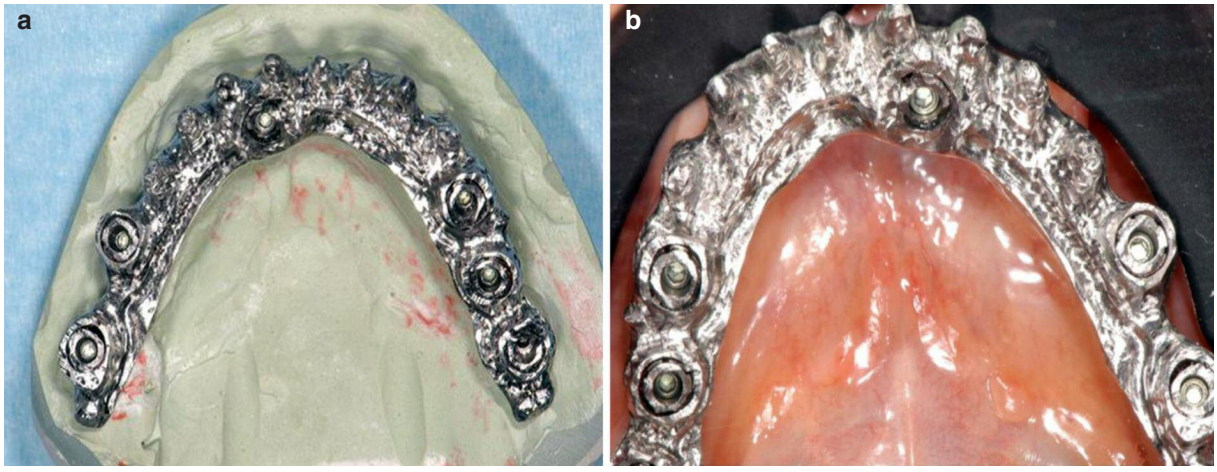

Figure 7
a) Metal bar realization and b) verification on the patient.

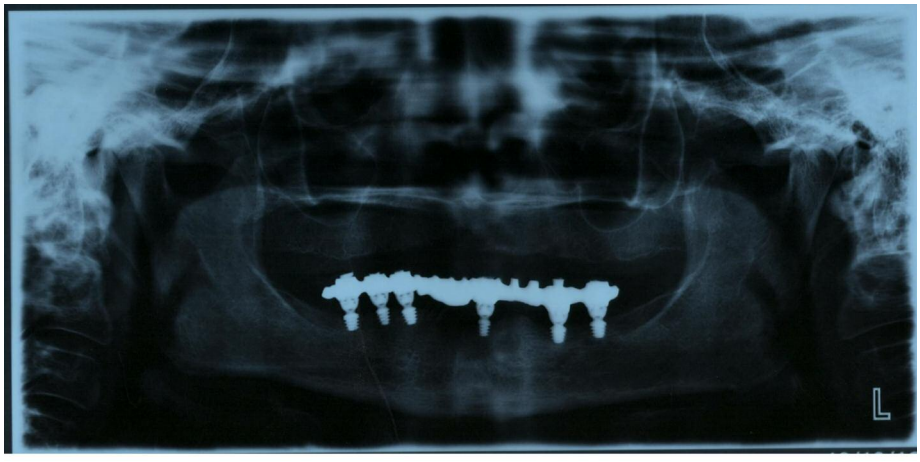

Figure 8
One-year OPT follow-up.

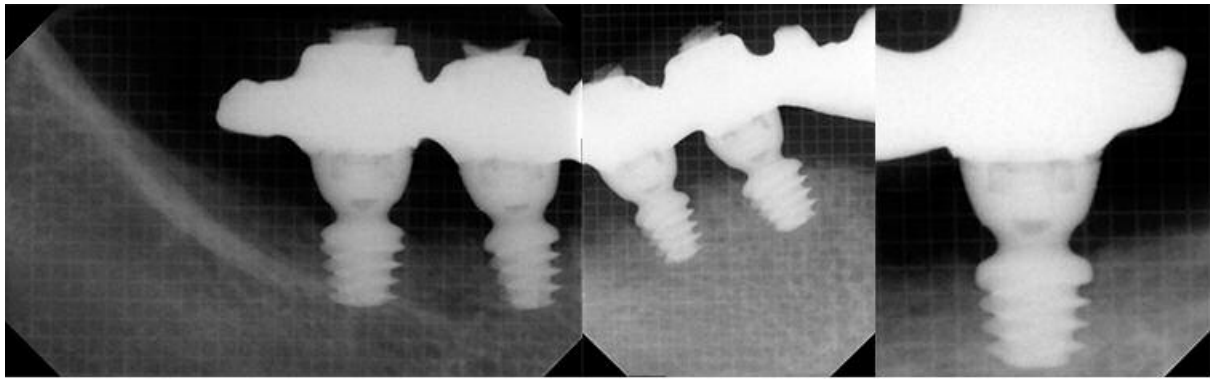

Figure 9
Periapical radiographs on ruled pellicles. Each square is measuring 1 mm. No marginal bone loss is observable.

Figure 10
View of the final prosthesis.

1. 'My crown/my bridge functions very well, and I can chew on it very well'
   Yes definitely
2. 'I feel more secure biting on my new prosthesis'
   Yes definitely
3. 'To speak, I can very well use my crown/bridge'
   Yes definitely
4. 'I am pleased with the aesthetic results'
   Yes definitely
5. 'I can clean my implants very well'
   Yes definitely
6. 'I got exactly what I expected'
   Enough
7. 'I would like this treatment again, if needed'.
   Yes definitely
8. 'I would recommend this treatment to a friend or relative, if indicated?
   Enough

Discussion

From a prosthodontics point of view, rehabilitating an edentulous mandible is a challenge for the dental operator. Patients are more demanding for a long-lasting fixed therapy solution (12).
The branch of implant dentistry helps in providing good therapeutic solutions, but to the conditions that adequate treatment planning and suitable protocols are strictly complied.
The combination of prosthodontics and surgical implant techniques allows to rehabilitate edentulous, atrophic mandibles while preserving noble anatomical structures, bone quality, aesthetic results and oral functionality.
Indeed, the overdentures prosthesis guides the implant placement, and the bio-morphology of the available bone, assessed by modern computed tomography cone beam exam (13), determines if the implants can be inserted in the planned sites.
The key role of the implant therapy success is the primary stability of the fixture in the bone, and consequently of the related supported prosthesis. The primary implant stability has a key role in achieving a successful osseointegration, and it is affected by factors related to the technical properties of implants (design, size, macro and micro surface), to the bone quality and quantity and to the surgical skills of the operator (14).
In order to fulfill the more crescent demands of these compromises between a safe osseointegration and a good prosthesis rehabilitation, researchers questioned on what could be modified: the implant surfaces, design, and sizes.
From the well-known studies of Tada et al. (15), the ratio between the bone and the implant surfaces and the stress distribution leaded to the idea that improving the macro and micro geometry of implants surfaces and playing on the ratio between diameters and length could supply the lack of implant solutions employable in case of atrophic mandible.
Short implants represent a solution to this challenge.
When short implants were proposed, the ratio of crown-implant length was considered unfavorable, thus pushing the studies of the crown-root ratio in natural teeth for a CAD-CAM (Computer-Aided Design-Computer-Aided Manufacturing) implant design (16, 17). Since then, survival and success rate of short implants have been systematically studied in order to reach a compromise in the optimal crown-root ratio for the fixed prosthetic implant. The improvement

of the total bone surface contact, the study of the forces distribution on the fixture, and the successes in clinical trials strongly suggest the use of the short implants when bone is not available or when the bone augmentation cannot be performed (7, 18-21).
In particular, in its systematic review in 2006, de Neves (22) analyzed the success rate of the short implants in longitudinal studies, and found that the use of 3.75x 7 mm type implant was successful. The numerous RCTs by Esposito et al. with the related updates and follow-up (23-25) supported the therapeutic efficacy in terms of survival rate and marginal bone loss of the short implants *vs* the longer implants placed in the vertical augmented atrophic mandible, recommending the use of short implants (5 mm-long) with a wide diameter (up to 6 mm).
In addition, Cannizzaro et al. in their RCT reported how the use of extra short implants (5.0 mm-long) supporting cross-arches prosthesis in edentulous mandibles and maxillae showed similar results as 11.5 mm-long implants (26).
Our case report differs from the well-known current technique All-on-Four, which uses four implants in the mandible to support overdenture prosthesis (27). In addition, in All-on-Four technique, the bone availability affects the placement of the tilted implants, possibly creating cantilevers in posterior areas. In the reported technique distribution of occlusal forces is homogenous, thanks to a prosthesis realized following the physiological occlusion of the patient.
Indeed, 6 extra-short implants were used, providing extra implant-bone surfaces supporting the prosthesis. This therapeutic approach could be economically demanding for the patient in the short term, but had the advantage of assuring a very promising, long-lasting clinical result.
At one-year follow-up, in fact, the radiological control showed a good health of the bone around the implants and signs of good osseointegration. At the oral examination, the prosthesis was found stable. Overall, the patient was satisfied with the results.
More clinical studies are needed to confirm the reliability of this oral rehabilitation protocol.

Conclusions

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Regenerative medicine, indeed, can provide a valid support in recovering the bone quantity necessary for the placement of a fixture, but still the outcomes of the available therapies such as Platelet-Rich-Fibrin and Concentrated Growth Factors membranes are still unpredictable (27, 28).

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